WHAT IS CLAIMED IS:

1. A magnetoresistive device, comprising:

a magnetization pinned layer of which magnetization direction is substantially pinned to one direction;

a magnetization free layer of which magnetization direction is changed in accordance with an external magnetic field;

a nonmagnetic intermediate layer formed between the magnetization pinned layer and the magnetization free layer; and

electrodes allowing a sense current to flow in a direction substantially perpendicular to the plane of the stack including the magnetization pinned layer, the nonmagnetic intermediate layer and the magnetization free layer,

wherein at least one of the magnetization pinned layer and the magnetization free layer is substantially formed of a binary alloy or a ternary alloy represented by general formula (1) or (2) given below:

$$T1_aT2_b \qquad (1)$$

$$Fe_cCo_dNi_e \qquad (2)$$

where T1 and T2 are different from each other and selected from the group consisting of Fe, Co and Ni, 25 at% $\leqq$ a $\leqq$ 75 at%, 25 at% $\leqq$ b $\leqq$ 75 at%, and a + b = 100; and

0 < c $\leqq$ 75 at%, 0 < d $\leqq$ 75 at%, 0 < e $\leqq$ 63 at%,

and c + d + e = 100.

2. A magnetoresistive device, comprising:

a magnetization pinned layer of which magnetization direction is substantially pinned to one direction;

a magnetization free layer of which magnetization direction is changed in accordance with an external magnetic field;

a nonmagnetic intermediate layer formed between the magnetization pinned layer and the magnetization free layer; and

electrodes allowing a sense current to flow in a direction substantially perpendicular to the plane of the stack including the magnetization pinned layer, the nonmagnetic intermediate layer and the magnetization free layer,

wherein at least one of the magnetization pinned layer and the magnetization free layer is formed of an alloy represented by general formula (3) or (4) given below:

$$(T1_{a/100}T2_{b/100})_{100-x}M1_x \quad (3)$$

$$(T1_{c/100}T2_{d/100}T3_{e/100})_{100-x}M1_x \quad (4)$$

where T1, T2 and T3 are different from each other and selected from the group consisting of Fe, Co and Ni; M1 is at least one element selected from the group consisting of Cr, V, Ta, Nb, Sc, Ti, Mn, Cu, Zn, Ga, Ge, Zr, Hf, Y, Tc, Re, Ru, Rh, Ir, Pd, Pt, Ag, Au, B,

Al, In, C, Si, Sn, Ca, Sr, Ba, O, N and F;

25 at% ≦ a ≦ 75 at%, 25 at% ≦ b ≦ 75 at%, and a + b = 100;

5 at% ≦ c ≦ 90 at%, 5 at%≦ d ≦ 90 at%, 5 at% ≦ e ≦ 90 at%, and c + d + e = 100; and

0.1 at% ≦ x ≦ 30 at%.

3. A magnetoresistive device, comprising:

a magnetization pinned layer of which magnetization direction is substantially pinned to one direction;

a magnetization free layer of which magnetization direction is changed in accordance with an external magnetic field;

a nonmagnetic intermediate layer formed between the magnetization pinned layer and the magnetization free layer; and

electrodes allowing a sense current to flow in a direction substantially perpendicular to the plane of the stack including the magnetization pinned layer, the nonmagnetic intermediate layer and the magnetization free layer,

wherein at least one of the magnetization pinned layer and the magnetization free layer is substantially formed of an alloy represented by general formula (5) given below:

$$Fe_{100-a}T1_a \qquad (5)$$

where T1 is at least one element selected from the

group consisting of Co, Cr, V, Ni, Rh, Ti, Mo, W, Nb, Ta, Pd, Pt, Zr and Hf; and

0 at% $\leqq$ a < 70 atomic %;

and wherein the alloy has a body-centered cubic crystal structure.

4. A magnetoresistive device, comprising

a magnetization pinned layer of which magnetization direction is substantially pinned to one direction;

a magnetization free layer of which magnetization direction is changed in accordance with an external magnetic field;

a nonmagnetic intermediate layer formed between the magnetization pinned layer and the magnetization free layer; and

electrodes allowing a sense current to flow in a direction substantially perpendicular to the plane of the stack including the magnetization pinned layer, the nonmagnetic intermediate layer and the magnetization free layer,

wherein at least one of the magnetization pinned layer and the magnetization free layer is substantially formed of an alloy represented by general formula (6) given below:

$$Fe_{100-a}T1_a \qquad (6)$$

where

0 at% $\leqq$ a $\leqq$ 80 at%, in the case where T1 is Co;

0 at% ≦ a ≦ 80 at%, in the case where T1 is Cr;

0 at% ≦ a ≦ 70 at%, in the case where T1 is V;

0 at% ≦ a ≦ 20 at%, in the case where T1 is Ni;

0 at% ≦ a ≦ 55 at%, in the case where T1 is Rh;

and

0 at% ≦ a ≦ 51 at%, in the case where T1 is Ti;

and wherein the alloy has a body-centered cubic crystal structure.

5. A magnetoresistive device, comprising:

a magnetization pinned layer of which magnetization direction is substantially pinned to one direction;

a magnetization free layer of which magnetization direction is changed in accordance with an external magnetic field;

a nonmagnetic intermediate layer formed between the magnetization pinned layer and the magnetization free layer; and

electrodes allowing a sense current to flow in a direction substantially perpendicular to the plane of the stack including the magnetization pinned layer, the nonmagnetic intermediate layer and the magnetization free layer,

wherein at least one of the magnetization pinned layer and the magnetization free layer is formed of a ternary alloy selected from the group consisting of an Fe-Co-Ni alloy, a Co-Mn-Fe alloy and an Fe-Cr-Co alloy;

and wherein the ternary alloy has a body-centered cubic crystal structure.

6. A magnetoresistive device, comprising:

a magnetization pinned layer of which magnetization direction is substantially pinned to one direction;

a magnetization free layer of which magnetization direction is changed in accordance with an external magnetic field;

a nonmagnetic intermediate layer formed between the magnetization pinned layer and the magnetization free layer; and

electrodes allowing a sense current to flow in a direction substantially perpendicular to the plane of the stack including the magnetization pinned layer, the nonmagnetic intermediate layer and the magnetization free layer,

wherein at least one of the magnetization pinned layer and the magnetization free layer is substantially formed of an alloy represented by any of general formulas (7) to (10) given below:

$$(Fe_{(100-a)/100}Tl_{a/100})_{100-x}M_x \quad (7)$$

$$(Fe\text{-}Co\text{-}Ni)_{100-x}M_x \quad (8)$$

$$(Co\text{-}Mn\text{-}Fe)_{100-x}M_x \quad (9)$$

$$(Fe\text{-}Cr\text{-}Co)_{100-x}M_x \quad (10)$$

where Tl is at least one element selected from the group consisting of Co, Cr, V, Ni, Rh, Ti, Mo, W, Nb,

Ta, Pd, Pt, Zr and Hf, and 0 at% ≦ a < 70 atomic %;

the Fe-Co-Ni alloy is in a composition region forming a body-centered cubic crystal;

the Co-Mn-Fe alloy is in a composition region forming a body-centered cubic crystal structure;

the Fe-Cr-Co alloy is in a composition region forming a body-centered cubic crystal structure;

0.1 at% ≦ x ≦ 20 at%, in the case where M is at least one element selected from the group consisting of Mn, Cu, Re, Ru, Pd, Pt, Ag, Au and Al; and

0.1 at% ≦ x ≦ 10 at%, in the case where M is at least one element selected from the group consisting of Sc, Zn, Ga, Ge, Zr, Hf, Y, Tc, B, In, C, Si, Sn, Ca, Sr, Ba, O, F and N;

and wherein the alloy has a body-centered cubic crystal structure.

7. A magnetoresistive device, comprising:

a magnetization pinned layer of which magnetization direction is substantially pinned to one direction;

a magnetization free layer of which magnetization direction is changed in accordance with an external magnetic field;

a nonmagnetic intermediate layer formed between the magnetization pinned layer and the magnetization free layer; and

electrodes allowing a sense current to flow in

a direction substantially perpendicular to the plane of the stack including the magnetization pinned layer, the nonmagnetic intermediate layer and the magnetization free layer,

wherein at least one of the magnetization pinned layer and the magnetization free layer is substantially formed of an alloy represented by general formula (11) given below:

$$(Fe_{(100-a)/100}T1_{a/100})_{100-x}M_x \quad (11)$$

where

0 at% ≦ a ≦ 80 at%, in the case where T1 is Co;

0 at% ≦ a ≦ 80 at%, in the case where T1 is Cr;

0 at% ≦ a ≦ 70 at%, in the case where T1 is V;

0 at% ≦ a ≦ 10 at%, in the case where T1 is Ni;

0 at% ≦ a ≦ 55 at%, in the case where T1 is Rh;

0 at% ≦ a ≦ 51 at%, in the case where T1 is Ti;

0.1 at% ≦ x ≦ 20 at%, in the case where M is at least one element selected from the group consisting of Mn, Cu, Re, Ru, Pd, Pt, Ag, Au and Al; and

0.1 at% ≦ x ≦ 10 at%, in the case where M is at least one element selected from the group consisting of Sc, Zn, Ga, Ge, Zr, Hf, Y, Tc, B, In, C, Si, Sn, Ca, Sr, Ba, O, F and N;

and wherein the alloy has a body-centered cubic crystal structure.

8. A magnetoresistive device, comprising:

a magnetization pinned layer of which

magnetization direction is substantially pinned to one direction;

a magnetization free layer of which magnetization direction is changed in accordance with an external magnetic field;

a nonmagnetic intermediate layer formed between the magnetization pinned layer and the magnetization free layer; and

electrodes allowing a sense current to flow in a direction substantially perpendicular to the plane of the stack including the magnetization pinned layer, the nonmagnetic intermediate layer and the magnetization free layer,

wherein at least one of the magnetization pinned layer and the magnetization free layer is substantially formed of an alloy represented by general formula (12) given below:

$$(Fe_{(100-a)/100}T1_{a/100})_{100-x}M_x \qquad (12)$$

where T1 is at least one element selected from the group consisting of Co and Ni, and 0 at% $\leqq$ a $\leqq$ 50 at%; and

M is at least one element selected from the group consisting of Sc, Ti, Mn, Cu, Zn, Ga, Ge, Zr, Hf, Y, Tc, Re, Ru, Rh, Ir, Pd, Pt, Ag, Au, B, Al, In, C, Si, Sn, Ca, Sr, Ba, O, N and F, and 0.1 at% $\leqq$ x $\leqq$ 30 at%.

9. A magnetoresistive device, comprising:

a magnetization pinned layer of which

magnetization direction is substantially pinned to one direction;

a magnetization free layer of which magnetization direction is changed in accordance with an external magnetic field;

a nonmagnetic intermediate layer formed between the magnetization pinned layer and the magnetization free layer; and

electrodes allowing a sense current to flow in a direction substantially perpendicular to the plane of the stack including the magnetization pinned layer, the nonmagnetic intermediate layer and the magnetization free layer,

wherein at least one of the magnetization pinned layer and the magnetization free layer is substantially formed of an alloy represented by general formula (13) given below:

$$(Fe_{(100-a)/100}T1_{a/100})_{100-x}M_x \qquad (13)$$

where T1 is at least one element selected from the group consisting of Co and Ni, and 0 at% $\leqq$ a $\leqq$ 50 at%; and

M is at least one element selected from the group consisting of Cu, Zn and Ga, and 0.1 at% $\leqq$ x $\leqq$ 30 at%.

10. A magnetoresistive device, comprising:

a magnetization pinned layer of which magnetization direction is substantially pinned to one direction;

a magnetization free layer of which magnetization direction is changed in accordance with an external magnetic field;

a nonmagnetic intermediate layer formed between the magnetization pinned layer and the magnetization free layer; and

electrodes allowing a sense current to flow in a direction substantially perpendicular to the plane of the stack including the magnetization pinned layer, the nonmagnetic intermediate layer and the magnetization free layer,

wherein at least one of the magnetization pinned layer and the magnetization free layer is substantially formed of an alloy represented by general formula (14) given below:

$$Fe_{100-x}M_x \qquad (14)$$

where M is at least one element selected from the group consisting of Co and Ni, and 0.1 at% $\leqq$ x $\leqq$ 5 at%.

11. A magnetoresistive device, comprising:

a magnetization pinned layer of which magnetization direction is substantially pinned to one direction;

a magnetization free layer of which magnetization direction is changed in accordance with an external magnetic field;

a nonmagnetic intermediate layer formed between

the magnetization pinned layer and the magnetization free layer; and

electrodes allowing a sense current to flow in a direction substantially perpendicular to the plane of the stack including the magnetization pinned layer, the nonmagnetic intermediate layer and the magnetization free layer,

wherein at least one of the magnetization pinned layer and the magnetization free layer is substantially formed of an alloy represented by general formula (15) given below:

$$(Co_{(100-a)/100}T1_{a/100})_{100-x}M_x \quad (15)$$

where T1 is at least one element selected from the group consisting of Fe and Ni, and 0 at% $\leqq$ a $\leqq$ 50 at%; and

M is at least one element selected from the group consisting of Cr, V, Ta, Nb, Sc, Ti, Mn, Cu, Zn, Ga, Ge, Zr, Hf, Y, Tc, Re, Ru, Rh, Ir, Pd, Pt, Ag, Au, B, Al, In, C, Si, Sn, Ca, Sr, Ba, O, N and F, and 0.1 at% $\leqq$ x $\leqq$ 30 at%.

12. A magnetoresistive device, comprising:

a magnetization pinned layer of which magnetization direction is substantially pinned to one direction;

a magnetization free layer of which magnetization direction is changed in accordance with an external magnetic field;

a nonmagnetic intermediate layer formed between the magnetization pinned layer and the magnetization free layer; and

electrodes allowing a sense current to flow in a direction substantially perpendicular to the plane of the stack including the magnetization pinned layer, the nonmagnetic intermediate layer and the magnetization free layer,

wherein at least one of the magnetization pinned layer and the magnetization free layer is substantially formed of an alloy represented by general formula (16) given below:

$$(Co_{(100-a)/100}T1_{a/100})_{100-x}M_x \qquad (16)$$

where T1 is at least one element selected from the group consisting of Fe and Ni, and 0 at% $\leqq$ a $\leqq$ 50 at%; and

M is at least one element selected from the group consisting of Sc, Ti, Mn, Cu and Hf, and 0.1 at% $\leqq$ x $\leqq$ 30 at%.

13. A magnetoresistive device, comprising:

a magnetization pinned layer of which magnetization direction is substantially pinned to one direction;

a magnetization free layer of which magnetization direction is changed in accordance with an external magnetic field;

a nonmagnetic intermediate layer formed between

the magnetization pinned layer and the magnetization free layer; and

electrodes allowing a sense current to flow in a direction substantially perpendicular to the plane of the stack including the magnetization pinned layer, the nonmagnetic intermediate layer and the magnetization free layer,

wherein at least one of the magnetization pinned layer and the magnetization free layer is substantially formed of an alloy represented by general formula (17) given below:

$$Co_{100-x}M_x \qquad (17)$$

where M is at least one element selected from the group consisting of Fe and Ni, and 0.1 at% $\leqq$ x $\leqq$ 5 at%.

14. A magnetoresistive device, comprising:

a magnetization pinned layer of which magnetization direction is substantially pinned to one direction;

a magnetization free layer of which magnetization direction is changed in accordance with an external magnetic field;

a nonmagnetic intermediate layer formed between the magnetization pinned layer and the magnetization free layer; and

electrodes allowing a sense current to flow in a direction substantially perpendicular to the plane of

the stack including the magnetization pinned layer, the nonmagnetic intermediate layer and the magnetization free layer,

wherein at least one of the magnetization pinned layer and the magnetization free layer is substantially formed of an alloy represented by general formula (18) given below:

$$(Ni_{(100-a)/100}T1_{a/100})_{100-x}M_x \quad (18)$$

where T1 is at least one element selected from the group consisting of Co and Fe, and 0 at% $\leqq$ a $\leqq$ 50 at%; and

M is at least one element selected from the group consisting of Cr, V, Ta, Nb, Sc, Ti, Mn, Cu, Zn, Ga, Ge, Zr, Hf, Y, Tc, Re, Ru, Rh, Ir, Pd, Pt, Ag, Au, B, Al, In, C, Si, Sn, Ca, Sr, Ba, O, N and F, and 0.1 at% $\leqq$ x $\leqq$ 30 at%.

15. A magnetoresistive device, comprising:

a magnetization pinned layer of which magnetization direction is substantially pinned to one direction;

a magnetization free layer of which magnetization direction is changed in accordance with an external magnetic field;

a nonmagnetic intermediate layer formed between the magnetization pinned layer and the magnetization free layer; and

electrodes allowing a sense current to flow in

a direction substantially perpendicular to the plane of the stack including the magnetization pinned layer, the nonmagnetic intermediate layer and the magnetization free layer,

wherein at least one of the magnetization pinned layer and the magnetization free layer is substantially formed of an alloy represented by general formula (19) given below:

$$(Ni_{(100-a)/100}T1_{a/100})_{100-x}M_x \quad (19)$$

where T1 is at least one element selected from the group consisting of Fe and Co, and 0 at% $\leqq$ a $\leqq$ 50 at%; and

M is at least one element selected from the group consisting of Sc, Ti, Mn, Zn, Ga, Ge, Zr and Hf, and 0.1 at% $\leqq$ x $\leqq$ 30 at%.

16. A magnetoresistive device, comprising:

a magnetization pinned layer of which magnetization direction is substantially pinned to one direction;

a magnetization free layer of which magnetization direction is changed in accordance with an external magnetic field;

a nonmagnetic intermediate layer formed between the magnetization pinned layer and the magnetization free layer; and

electrodes allowing a sense current to flow in a direction substantially perpendicular to the plane of

the stack including the magnetization pinned layer, the nonmagnetic intermediate layer and the magnetization free layer,

wherein at least one of the magnetization pinned layer and the magnetization free layer is substantially formed of an alloy represented by general formula (20) given below:

$$Ni_{100-x}M_x \qquad (20)$$

where M is at least one element selected from the group consisting of Fe and Co, and 0.1 at% $\leqq$ x $\leqq$ 5 at%.

17. A magnetoresistive device, comprising:

a magnetization pinned layer of which magnetization direction is substantially pinned to one direction;

a magnetization free layer of which magnetization direction is changed in accordance with an external magnetic field;

a nonmagnetic intermediate layer formed between the magnetization pinned layer and the magnetization free layer; and

electrodes allowing a sense current to flow in a direction substantially perpendicular to the plane of the stack including the magnetization pinned layer, the nonmagnetic intermediate layer and the magnetization free layer,

wherein at least one of the magnetization pinned

layer and the magnetization free layer is substantially formed of a binary alloy or a ternary alloy represented by general formula (21-a) or (21-b) given below:

$$(T1_aT2_b)_{100-x}M_x \qquad (21\text{-}a)$$

$$(Fe_cCo_dNi_e)_{100-x}M_x \qquad (21\text{-}b)$$

where T1 and T2 are different from each other and selected from the group consisting of Fe, Co and Ni, 25 at% $\leqq$ a $\leqq$ 75 at%, 25 at% $\leqq$ b $\leqq$ 75 at%, and a + b = 100;

0 < c $\leqq$ 75 at%, 0 < d $\leqq$ 75 at%, 0 < e $\leqq$ 63 at%, and c + d + e = 100; and

M is at least one element selected from the group consisting of Cr, V, Ta, Nb, Sc, Ti, Mn, Cu, Zn, Ga, Ge, Zr, Hf, Y, Tc, Re, Ru, Rh, Ir, Pd, Pt, Ag, Au, B, Al, In, C, Si, Sn, Ca, Sr, Ba, O, N and F, and

0.1 at% $\leqq$ x $\leqq$ 20 at%.

18. A magnetoresistive device, comprising:

a magnetization pinned layer of which magnetization direction is substantially pinned to one direction;

a magnetization free layer of which magnetization direction is changed in accordance with an external magnetic field;

a nonmagnetic intermediate layer formed between the magnetization pinned layer and the magnetization free layer; and

electrodes allowing a sense current to flow in

a direction substantially perpendicular to the plane of the stack including the magnetization pinned layer, the nonmagnetic intermediate layer and the magnetization free layer,

wherein at least one of the magnetization pinned layer and the magnetization free layer has a laminate structure comprising alternately laminated layers of:

(i) at least one layer substantially formed of an alloy represented by general formula (22-a) or (22-b) given below:

$$T1_aT2_b \qquad (22\text{-}a)$$

$$Fe_cCo_dNi_e \qquad (22\text{-}b)$$

where T1 and T2 are different from each other and selected from the group consisting of Fe, Co and Ni, 25 at% $\leqq$ a $\leqq$ 75 at%, 25 at% $\leqq$ b $\leqq$ 75 at%, and a + b = 100; and

0 < c $\leqq$ 75 at%, 0 < d $\leqq$ 75 at%, 0 < e $\leqq$ 63 at%, and c + d + e = 100; and

(ii) at least one layer formed of at least one element selected from the group consisting of Cr, V, Ta, Nb, Sc, Ti, Mn, Cu, Zn, Ga, Ge, Zr, Hf, Y, Tc, Re, Ru, Rh, Ir, Pd, Pt, Ag, Au, B, Al, In, C, Si, Sn, Ca, Sr, Ba, O, N and F, and having a thickness falling within a range of between 0.03 nm and 1 nm.

19. A magnetoresistive device, comprising:

a magnetization pinned layer of which magnetization direction is substantially pinned to one

direction;

a magnetization free layer of which magnetization direction is changed in accordance with an external magnetic field;

a nonmagnetic intermediate layer formed between the magnetization pinned layer and the magnetization free layer; and

electrodes allowing a sense current to flow in a direction substantially perpendicular to the plane of the stack including the magnetization pinned layer, the nonmagnetic intermediate layer and the magnetization free layer,

wherein at least one of the magnetization pinned layer and the magnetization free layer is substantially formed of an alloy represented by general formula (23) or (24) given below:

$$(Ni_aFe_bCo_c)_{100-x}M_x \qquad (23)$$

$$(Ni_dFe_{100-d})_{100-x}M_x \qquad (24)$$

where $0 < a \leqq 75$ at%, $0 < b \leqq 75$ at%, $0 < c \leqq 75$ at%, and $a + b = 100$;

75 at% $\leqq d \leqq 85$ at%; and

M is at least one element selected from the group consisting of Cr, V, Ta, Nb, Sc, Ti, Mn, Cu, Zn, Ga, Ge, Zr, Hf, Y, Tc, Re, Ru, Rh, Ir, Pd, Pt, Ag, Au, B, Al, In, C, Si, Sn, Ca, Sr, Ba, O, N and F, and

0.1 at% $\leqq x \leqq 20$ at%.

20. A magnetoresistive device, comprising:

a magnetization pinned layer of which magnetization direction is substantially pinned to one direction;

a magnetization free layer of which magnetization direction is changed in accordance with an external magnetic field;

a nonmagnetic intermediate layer formed between the magnetization pinned layer and the magnetization free layer; and

electrodes allowing a sense current to flow in a direction substantially perpendicular to the plane of the stack including the magnetization pinned layer, the nonmagnetic intermediate layer and the magnetization free layer,

wherein at least one of the magnetization pinned layer and the magnetization free layer has a laminate structure comprising alternately laminated layers of:

(i) at least one layer substantially formed of an alloy represented by general formula (25) or (26) given below:

$Ni_aFe_bCo_c$ (25)

Ni_dFe_{100-d} (26)

where $0 < a \leqq 75$ at%, $0 < b \leqq 75$ at%, $0 < c \leqq 75$ at%, and $a + b = 100$; and

75 at% $\leqq d \leqq 85$ at%; and

(ii) at least one layer formed of at least one element selected from the group consisting of Cr, V,

Ta, Nb, Sc, Ti, Mn, Cu, Zn, Ga, Ge, Zr, Hf, Y, Tc, Re, Ru, Rh, Ir, Pd, Pt, Ag, Au, B, Al, In, C, Si, Sn, Ca, Sr, Ba, O, N and F, and having a thickness falling within a range of between 0.03 nm and 1 nm.

21. A magnetoresistive device, comprising:

a magnetization pinned layer of which magnetization direction is substantially pinned to one direction;

a magnetization free layer of which magnetization direction is changed in accordance with an external magnetic field;

a nonmagnetic intermediate layer formed between the magnetization pinned layer and the magnetization free layer; and

electrodes allowing a sense current to flow in a direction substantially perpendicular to the plane of the stack including the magnetization pinned layer, the nonmagnetic intermediate layer and the magnetization free layer,

wherein the magnetization pinned layer is substantially formed of an alloy represented by general formula (27) or (28) given below:

$$(Fe_aCo_bNi_c)_{100-x}M_x \qquad (27)$$

$$(Fe_dCo_{100-d})_{100-x}M_x \qquad (28)$$

where $0 < a \leqq 75$ at%, $0 < b \leqq 75$ at%, $0 < c \leqq 75$ at%, and $a + b = 100$;

45 at% $\leqq d \leqq 55$ at%; and

M is at least one element selected from the group consisting of Cr, V, Ta, Nb, Sc, Ti, Mn, Cu, Zn, Ga, Ge, Zr, Hf, Y, Tc, Re, Ru, Rh, Ir, Pd, Pt, Ag, Au, B, Al, In, C, Si, Sn, Ca, Sr, Ba, O, N and F, and

$0.1 \text{ at\%} \leqq x \leqq 20 \text{ at\%}$,

and wherein the magnetization free layer is substantially formed of an alloy represented by general formula (29) or (30) given below:

$$(Ni_eFe_fCo_g)_{100-x}M_x \qquad (29)$$

$$(Ni_hFe_{100-h})_{100-x}M_x \qquad (30)$$

where $60 \text{ at\%} \leqq e \leqq 75 \text{ at\%}$, $12.5 \text{ at\%} \leqq f \leqq 20 \text{ at\%}$, $12.5 \text{ at\%} \leqq g \leqq 20 \text{ at\%}$, and $e + f + g = 100$;

$75 \text{ at\%} \leqq h \leqq 85 \text{ at\%}$; and

M is at least one element selected from the group consisting of Cr, V, Ta, Nb, Sc, Ti, Mn, Cu, Zn, Ga, Ge, Zr, Hf, Y, Tc, Re, Ru, Rh, Ir, Pd, Pt, Ag, Au, B, Al, In, C, Si, Sn, Ca, Sr, Ba, O, N and F, and

$0.1 \text{ at\%} \leqq x \leqq 20 \text{ at\%}$.

22. A magnetoresistive device, comprising:

a magnetization pinned layer of which magnetization direction is substantially pinned to one direction;

a magnetization free layer of which magnetization direction is changed in accordance with an external magnetic field;

a nonmagnetic intermediate layer formed between the magnetization pinned layer and the magnetization

free layer; and

electrodes allowing a sense current to flow in a direction substantially perpendicular to the plane of the stack including the magnetization pinned layer, the nonmagnetic intermediate layer and the magnetization free layer,

wherein the magnetization pinned layer has a laminate structure comprising alternately laminated layers of:

(i) at least one layer substantially formed of an alloy represented by general formula (31) or (32) given below:

$Fe_aCo_bNi_C$ (31)

Fe_dCo_{100-d} (32)

where $0 < a \leqq 75$ at%, $0 < b \leqq 75$ at%, $0 < c \leqq 75$ at%, and $a + b = 100$;

45 at% $\leqq d \leqq 55$ at%; and

(ii) at least one layer formed of at least one element selected from the group consisting of Cr, V, Ta, Nb, Sc, Ti, Mn, Cu, Zn, Ga, Ge, Zr, Hf, Y, Tc, Re, Ru, Rh, Ir, Pd, Pt, Ag, Au, B, Al, In, C, Si, Sn, Ca, Sr, Ba, O, N and F, and having a thickness falling within a range of between 0.03 nm and 1 nm,

and wherein the magnetization free layer has a laminate structure comprising alternately laminated layers of:

(i) at least one layer substantially formed of

an alloy represented by general formula (33) or (34) given below:

$Ni_eFe_fCo_g$ (33)

Ni_hFe_{100-h} (34)

where 60 at% $\leqq$ e $\leqq$ 75 at%, 12.5 at% $\leqq$ f $\leqq$ 20 at%, 12.5 at% $\leqq$ g $\leqq$ 20 at%, and e + f + g = 100;

75 at% $\leqq$ h $\leqq$ 85 at%; and

(ii) at least one layer formed of at least one element selected from the group consisting of Cr, V, Ta, Nb, Sc, Ti, Mn, Cu, Zn, Ga, Ge, Zr, Hf, Y, Tc, Re, Ru, Rh, Ir, Pd, Pt, Ag, Au, B, Al, In, C, Si, Sn, Ca, Sr, Ba, O, N and F, and having a thickness falling within a range of between 0.03 nm and 1 nm.

23. A magnetic head comprising the magnetoresistive device according to any of claims 1 to 22.

24. A magnetic recording-reproducing apparatus, comprising a magnetic recording medium, and the magnetoresistive device according to any of claims 1 to 22.

ABSTRACT OF THE DISCLOSURE

A magnetoresistive device includes a magnetization pinned layer, a magnetization free layer, a nonmagnetic intermediate layer formed between the magnetization pinned layer and the magnetization free layer, and electrodes allowing a sense current to flow in a direction substantially perpendicular to the plane of the stack including the magnetization pinned layer, the nonmagnetic intermediate layer and the magnetization free layer. At least one of the magnetization pinned layer and the magnetization free layer is substantially formed of a binary or ternary alloy represented by the formula $Fe_aCo_bNi_c$ (where a + b + c = 100 at%, and $a \leqq 75$ at%, $b \leqq 75$ at%, and $c \leqq 63$ at%), or formed of an alloy having a body-centered cubic crystal structure.

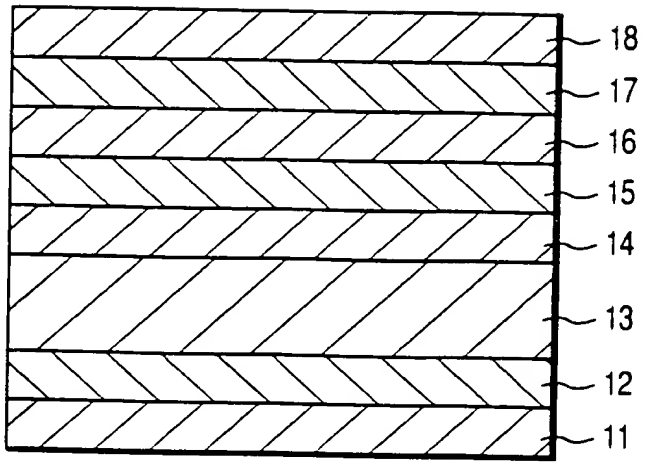

FIG. 1

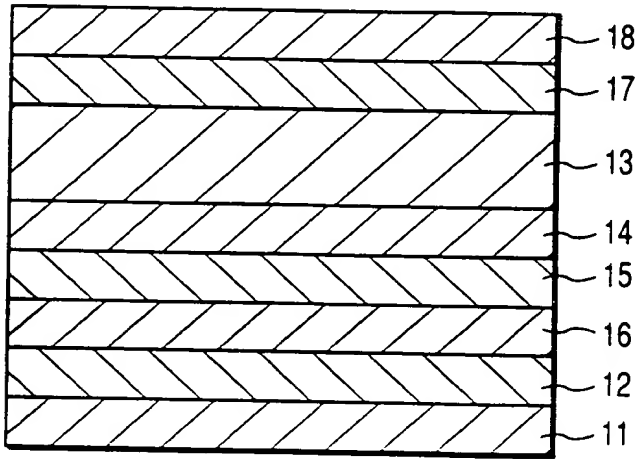

FIG. 2

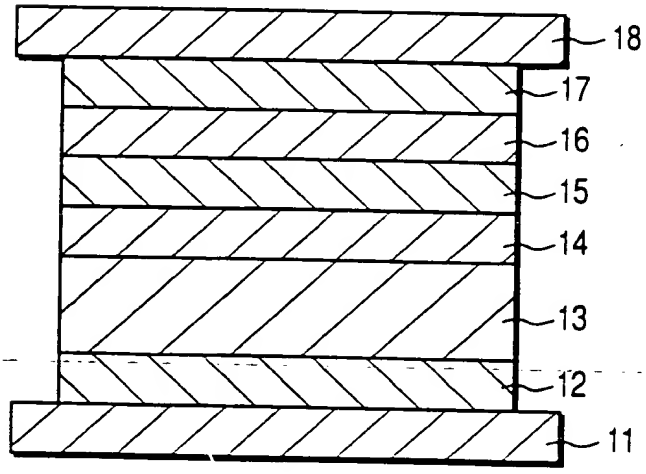

FIG. 3

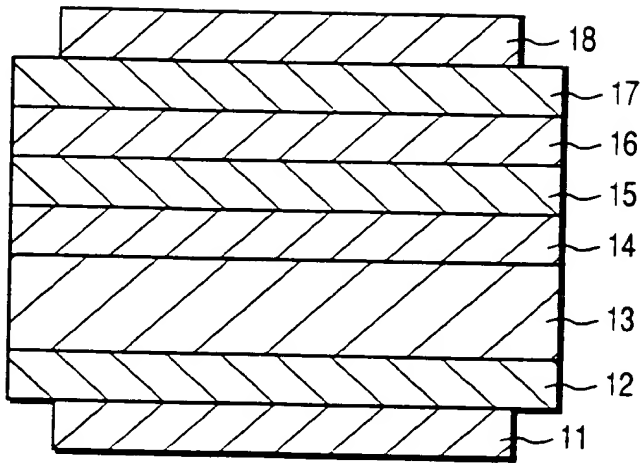

FIG. 4

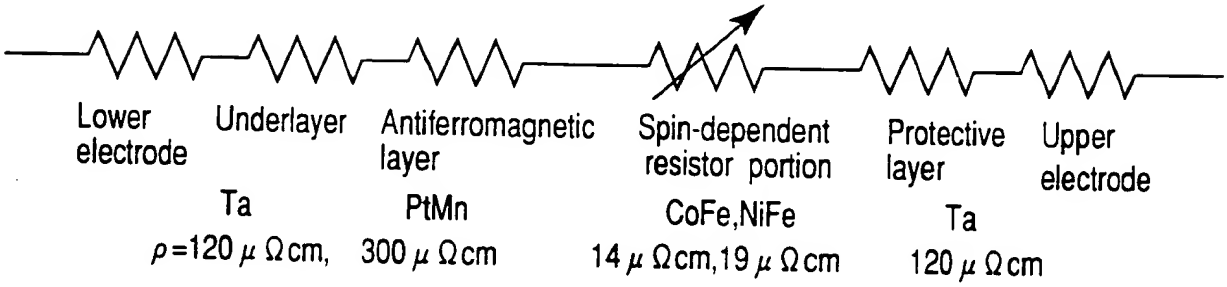

FIG. 5

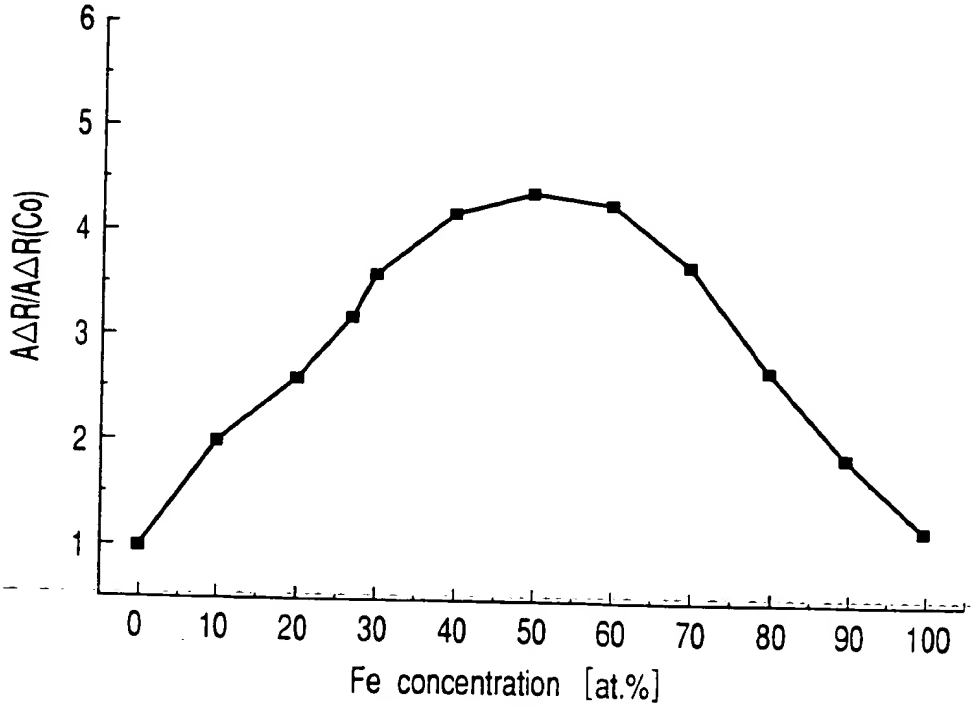

FIG. 6

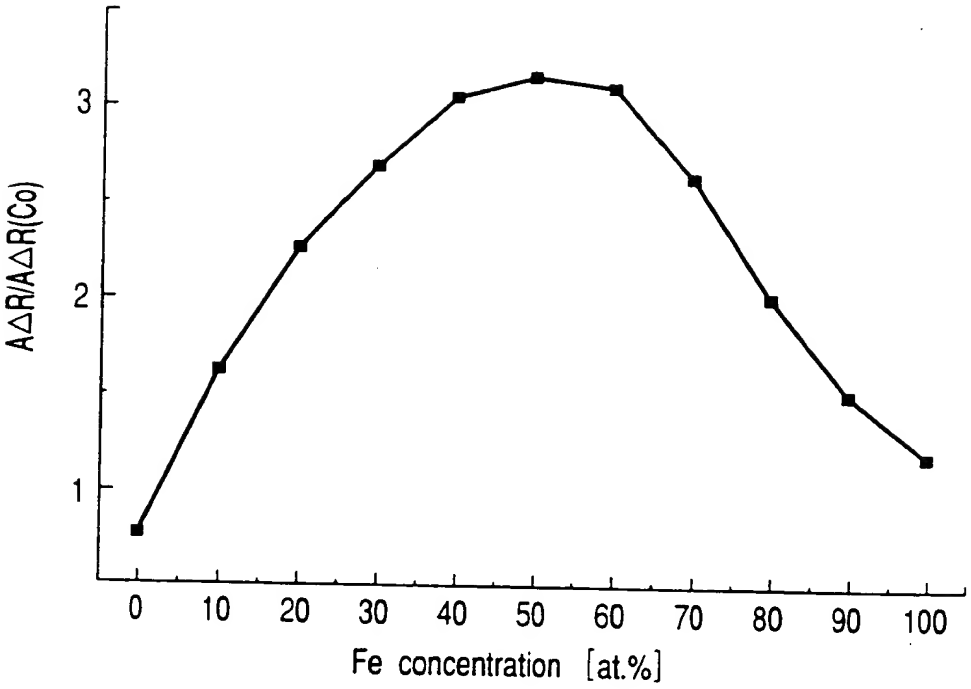

FIG. 7

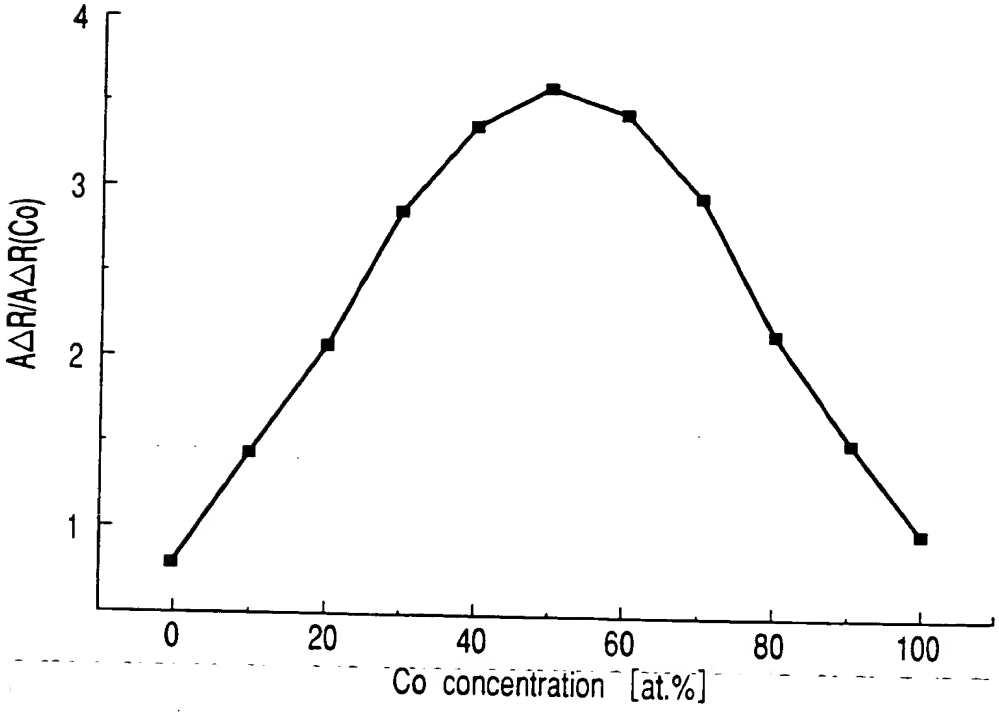

FIG. 8

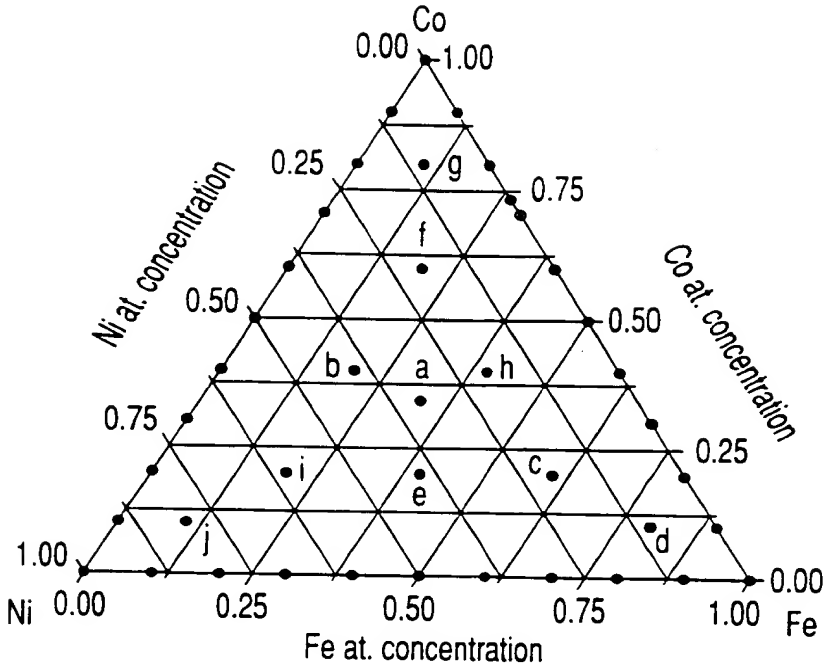

FIG. 9

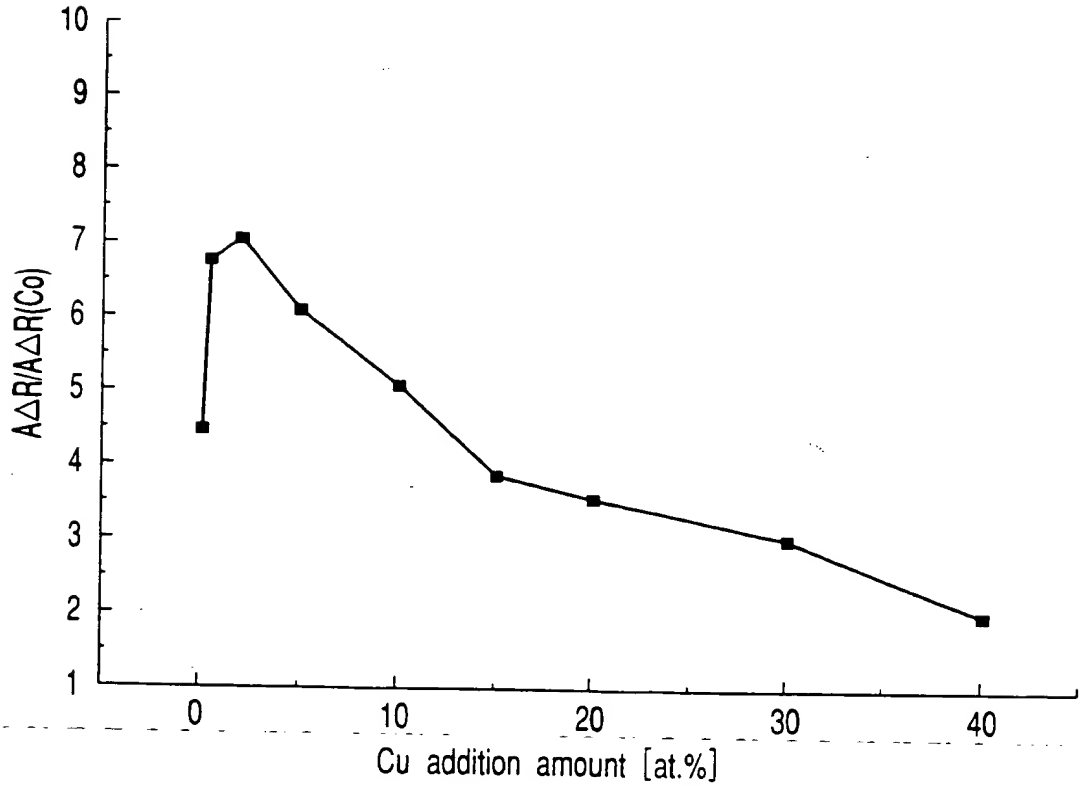

FIG. 11

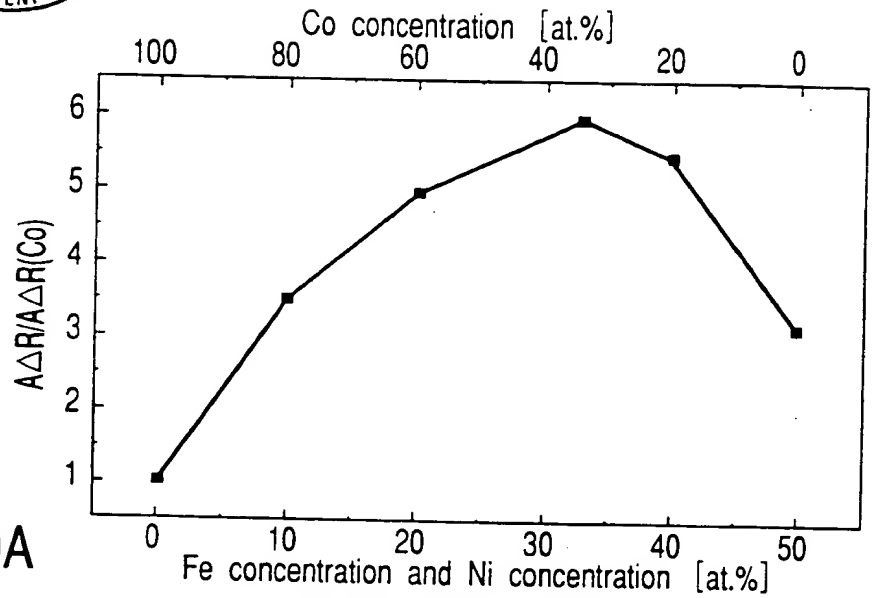

FIG. 10A

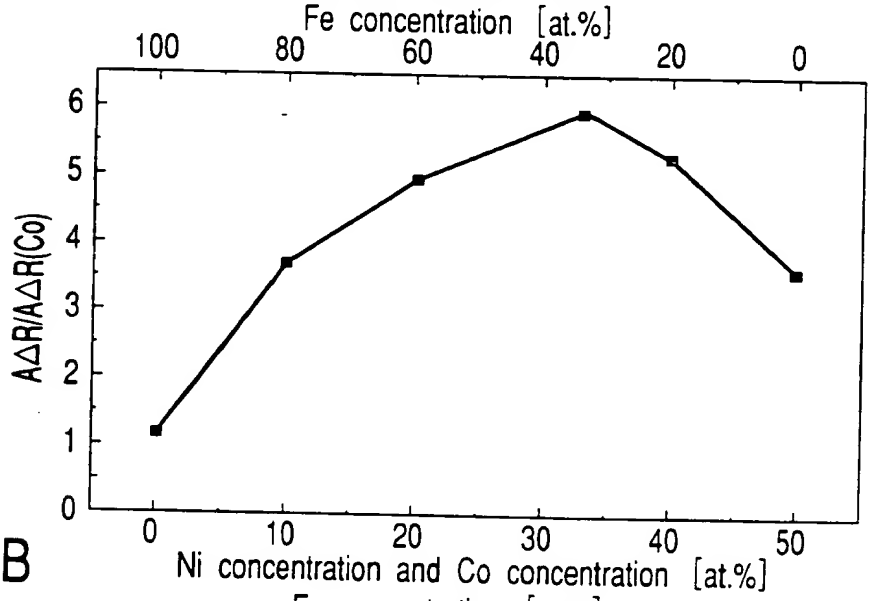

FIG. 10B

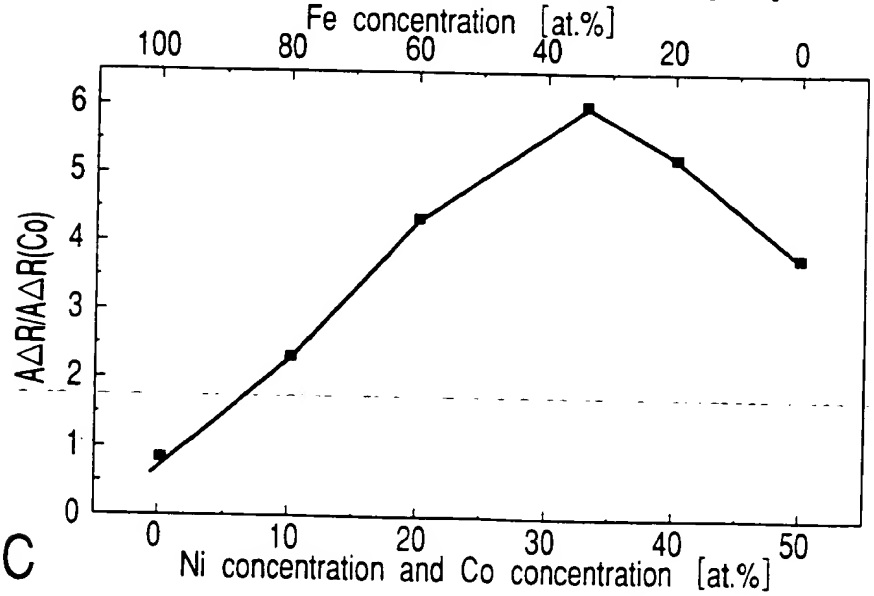

FIG. 10C

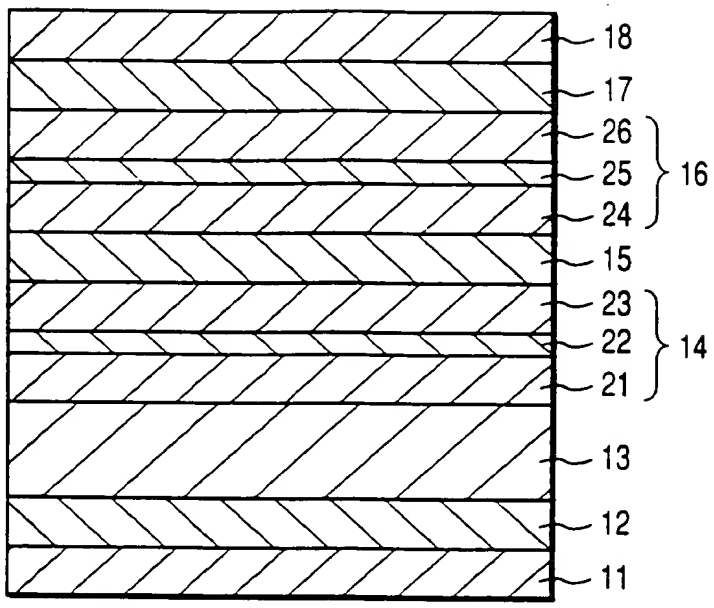

FIG. 12

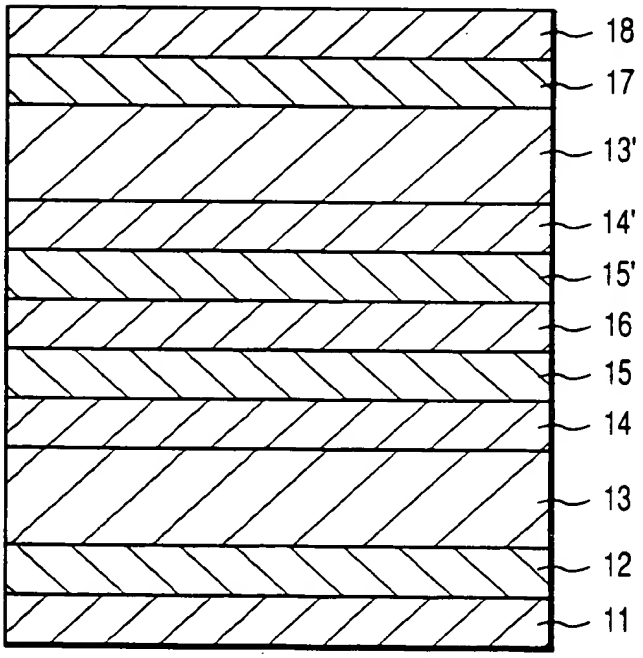

FIG. 13

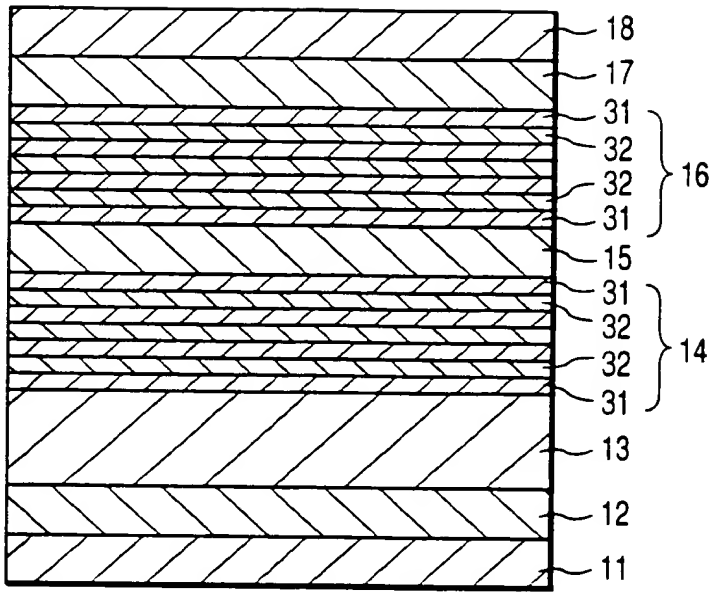

FIG. 14

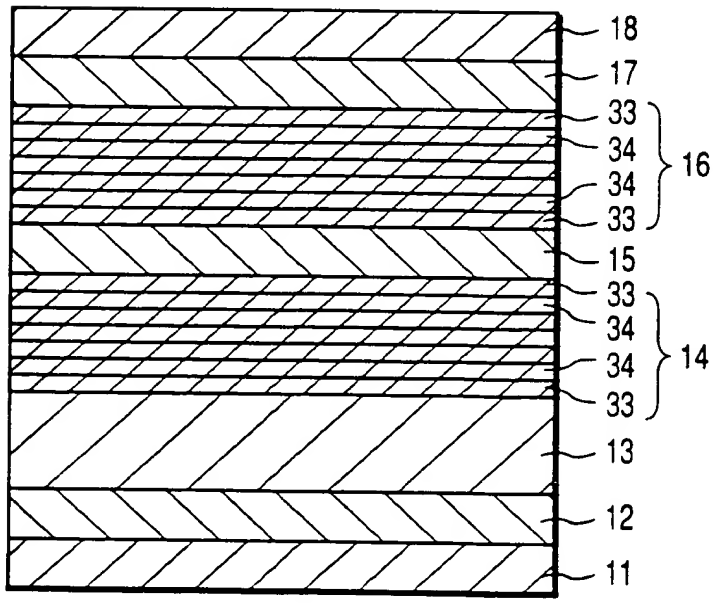

FIG. 15

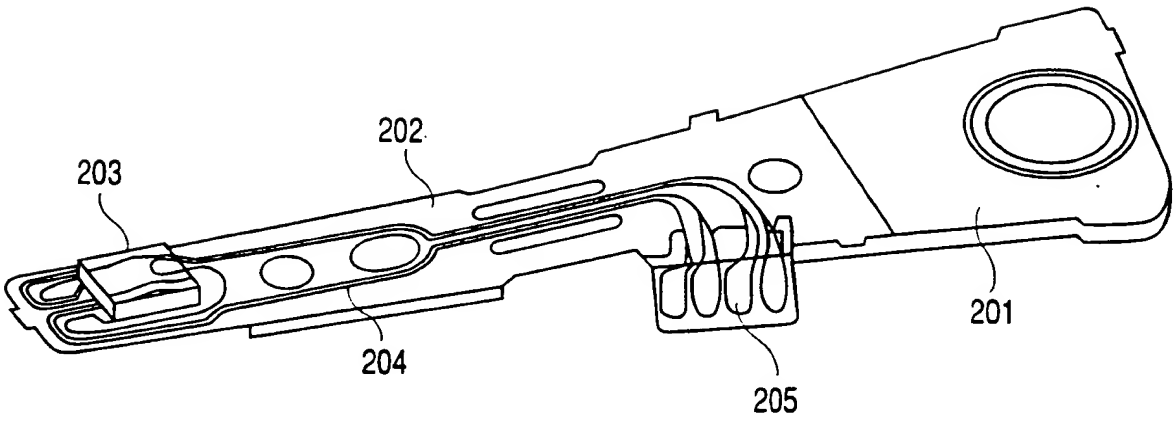

FIG. 16A

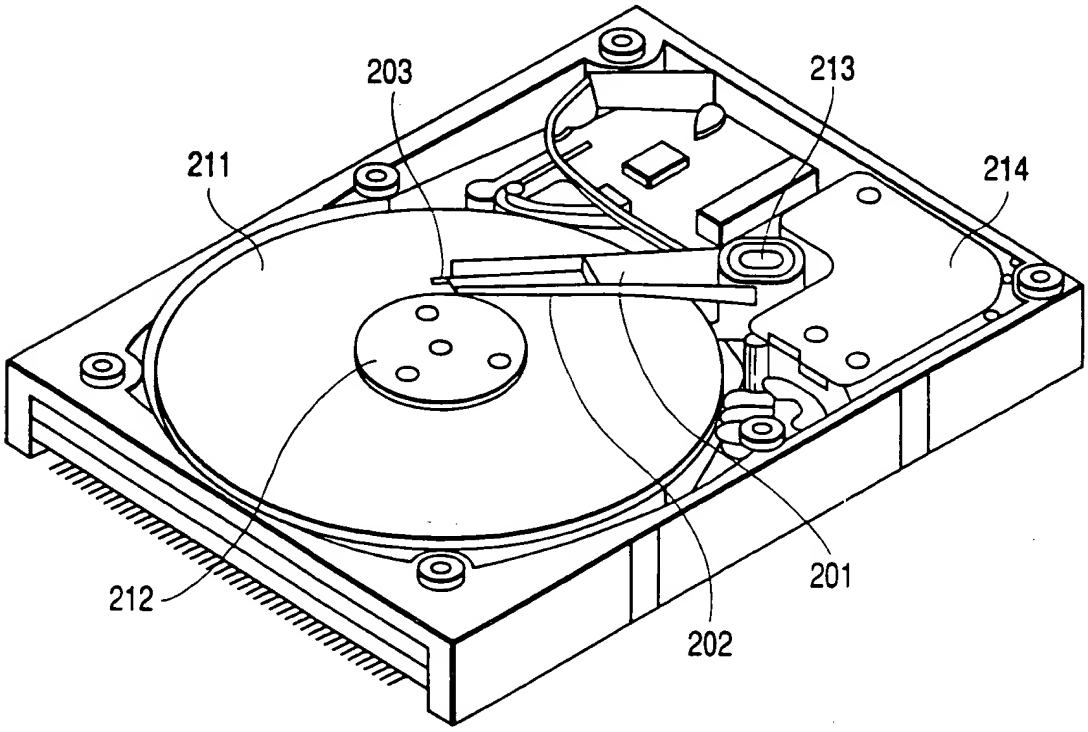

FIG. 16B

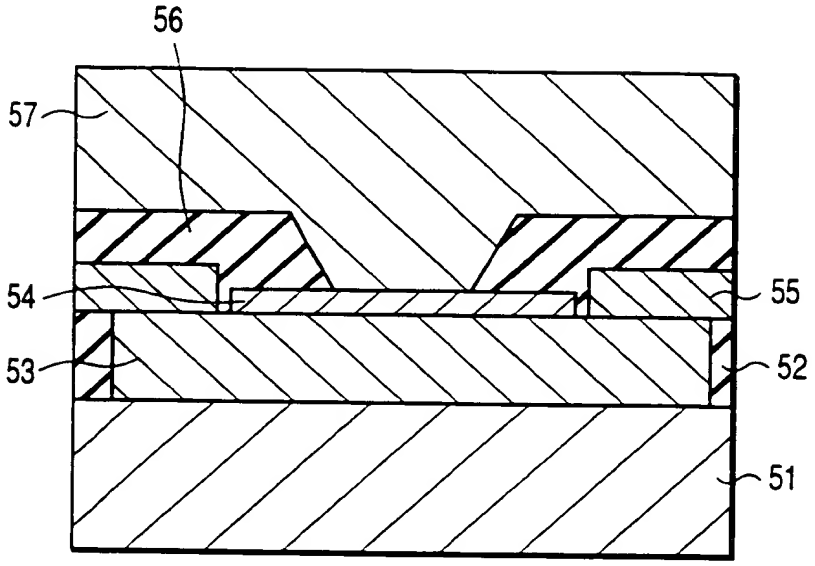

FIG. 17

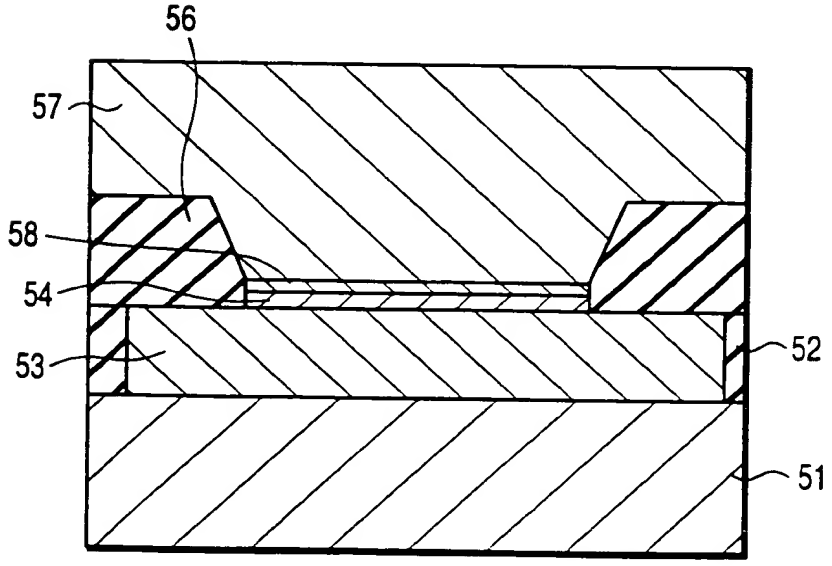

FIG. 18

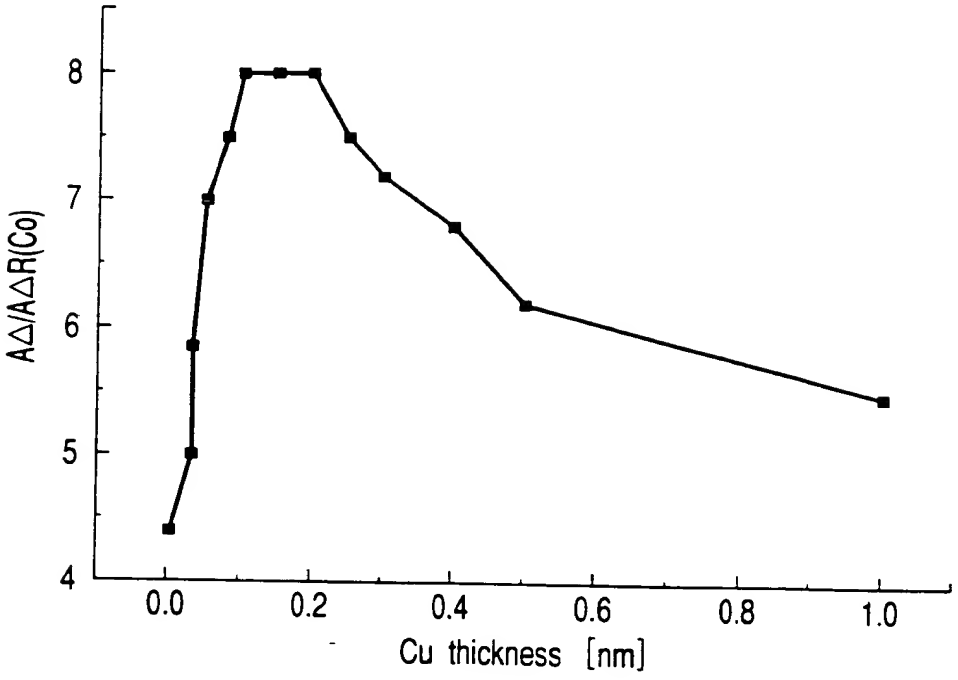

FIG. 19

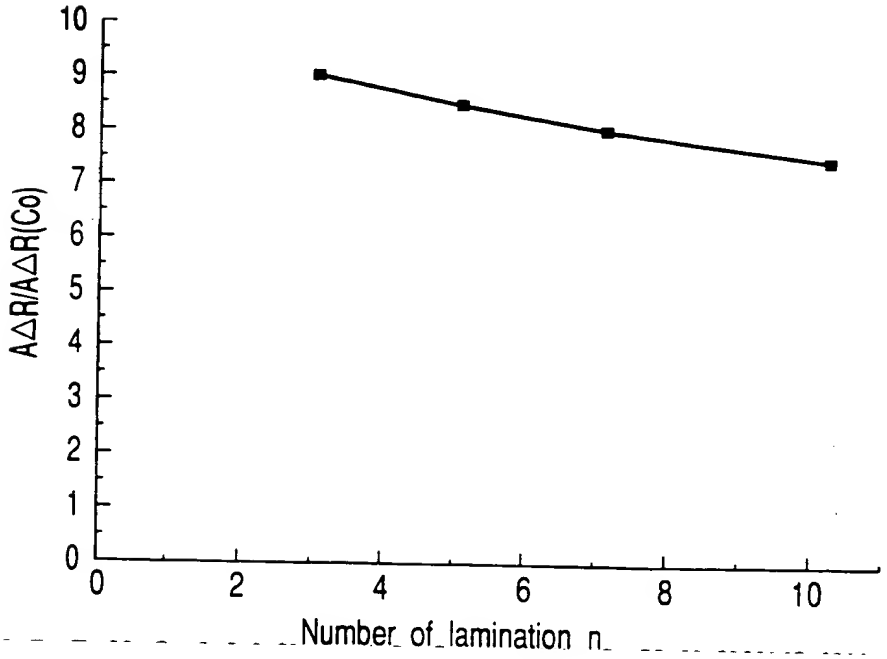

FIG. 22

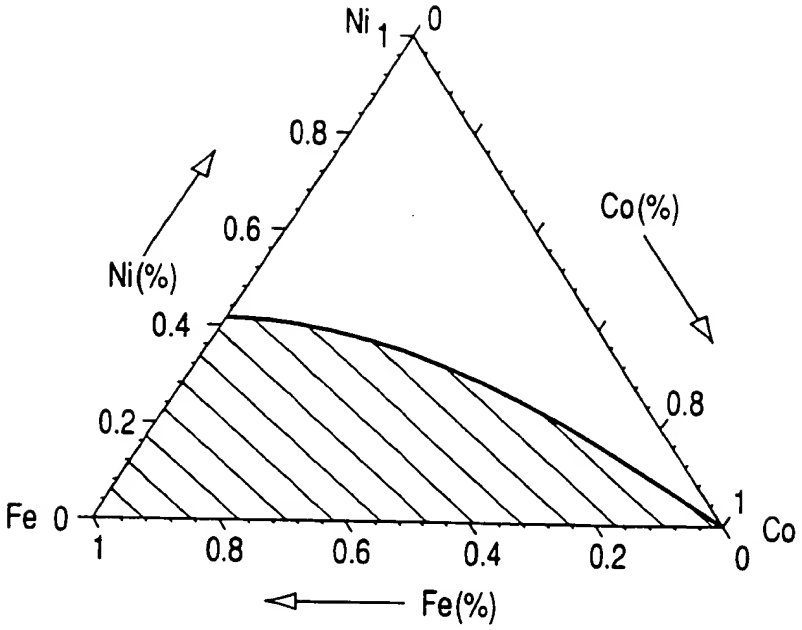

FIG. 20

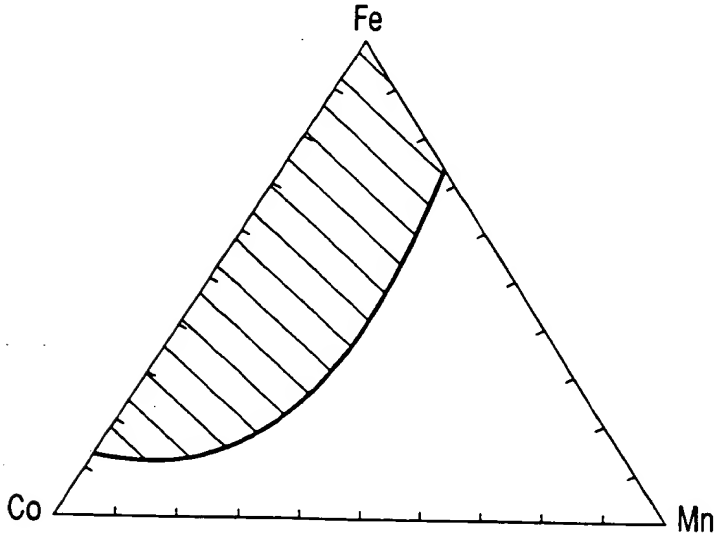

FIG. 21